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Developing Metrics for a Multi-Agency Harbour Safety and Security Exercise

Marine security, specifically port and harbour security, has been identified as one of the Government of Canada's priorities. Harbour security is a complex problem because of the multiplicity of threats - air, land and water, and because of the potential for overlapping jurisdictions within the harbour environment. In response, Defence Research and Development Canada – Atlantic examined existing inter-agency processes in a major harbour and developed metrics for use during a live multi-agency harbour safety and security exercise. This paper gives an overview of the metrics that were developed, and highlights the challenges encountered while deploying these metrics during a live exercise.

1. Introduction

Given present realities in the security and defence of North America, the Canadian government has clearly articulated its commitment to improve marine security in Canada's territorial waters and shore facilities (1). A key component of this strategy is the insistence that marine security, emphasizing harbour security, be given priority in the establishment of an integrated, interdepartmental approach. In response, Defence Research and Development Canada (DRDC) and Public Safety Canada (PS) collaborated on a multi-agency safety and security exercise in Halifax Harbour. DRDC formed the Interagency Harbour Security Coordination (IHSC) project and PS designed and led a large multi-agency exercise. The IHSC project was funded by the Marine Security Coordination Fund[1], administered by the Interdepartmental Marine Security Working Group (IMSWG)[2]. The IHSC focused on mapping interdepartmental processes, such as command and control and information sharing, and developed metrics for use during a live multi-agency harbour safety and security exercise.

The interdepartmental process mapping completed for the IHSC project documented existing multi-agency processes in the Port of Halifax. The metrics and data collection focused on the assessment of command and control and interdepartmental communications during a live multi-agency exercise. Exercise evaluation and improvement planning guidance provided by the U.S. Homeland Security Exercise and Evaluation Program (HSEEP) formed an integral part of the early metrics development (2). The live exercise was a full-scale marine safety, security, and consequence management exercise in the Halifax Harbour on October 21, 2009. It included Harbour stakeholders, three levels of government and the private sector. The duration of the full-scale exercise (on site in Halifax) was 10 hours, with a simulated national headquarters cell stood up in Ottawa for a period of 9 hours.

This paper provides an overview of the IHSC project. The focus of the discussion is on the evaluation developed for the multi-agency live exercise and how it was executed. Effort has been made to highlight the challenges encountered during this project, and to provide advice on how these challenges can potentially be mitigated.

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[1] The Marine Security Coordination Fund was established to fund one-time or limited-period projects that intend to enhance collaboration and coordination of Federal departments and agencies on marine security related activities.

[2] The Interdepartmental Marine Security Working group is chaired byTransport Canada with representatives from over 17 Federal departments and agencies.

2. Live Multi-Agency Safety and Security Exercise: Scenario and Evaluation

2.1. Scenario – General Description

The general scenario for the exercise was divided in two geographic areas with three main events triggering the response. The first event involved a container ship that developed a critical equipment failure and was awaiting repairs. While at anchor a string of explosions on the ship triggered a fire that caused the subsequent release of bunker fuel into the Harbour. After the explosion, the body of a foreign national non-crewmember was found near the stricken vessel with ties to a terrorist organization. The second event involved the ignition of a container of Sodium hydrosulphite causing a plume of toxic smoke that was carried inland over a densely populated urban area. The third event involved a security incident at an oil production facility on the Halifax harbour that may be connected to container ship explosion.
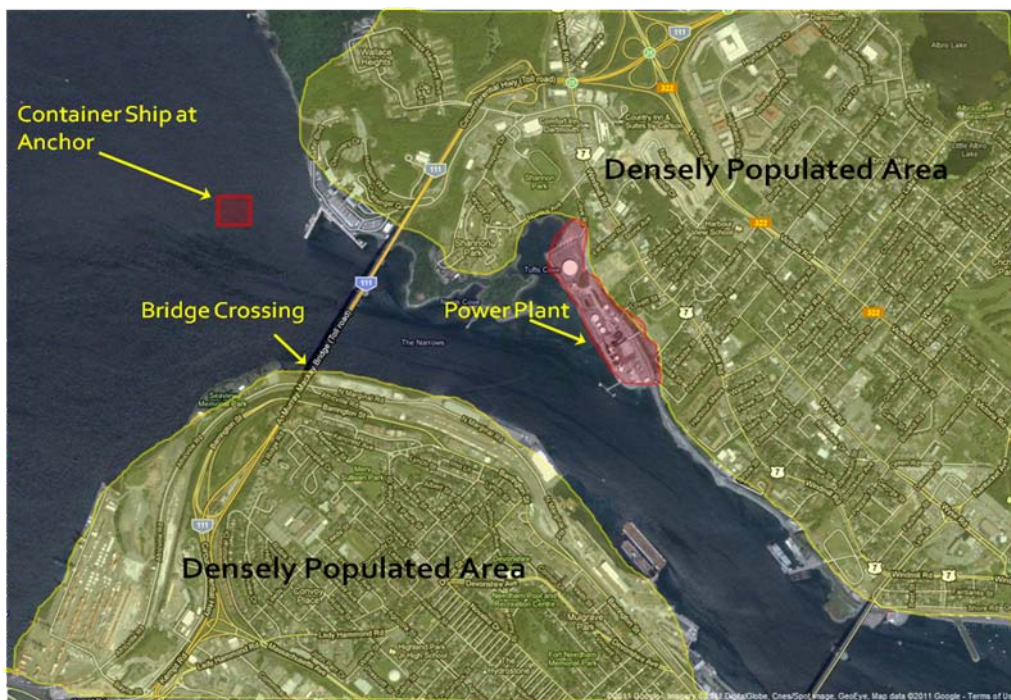
Figure 1: Primary event location in Halifax Harbour for the simulated container ship fire and on-water emergency response.

2.2. Scenario - Exercise Assumptions, Artificialities, and Constraints

Assumptions, artificiality, and constraints are a fact of life during the planning and execution of a live exercise. The focus of this section is to highlight the factors that directly affected the development of metrics and the data collection component of the IHSC project. Most of these factors are not unique to a specific live exercise, rather, they could be considered systemic to multi-level emergency management exercises.

2.2.1. Exercise Assumptions

Exercise assumptions made prior to developing the live exercise evaluation concerned the actions of exercise participants. The primary assumption was that exercise participants were all well versed in their own department/agency response plans and procedures, and that participants would act in accordance

with these existing plans, policies, and procedures. In addition, it was assumed that real-world emergency response actions would take priority over exercise actions.

2.2.2. Exercise Artificialities

Exercise artificialities were made to allow the exercise to proceed even if it would not proceed under normal circumstances. This included simulated support from federal departments' National headquarters, artificial weather and tidal information, use of alternative communication frequencies, simulated maritime exclusion zone orders, and use of some non-standard equipment. If an expected action did not occur as described in the Master Scenario Events List (MSEL) the exercise control group would force the action to ensure the MSEL timeline is preserved. Lastly, some decision timelines were shortened to allow for increased exercise play.

2.2.3. Constraints

Several constraints were present during the IHSC that influenced the development of metrics. Early in the IHSC, a conscious decision was made to avoid evaluating internal processes of participating agencies and departments, instead focusing the evaluation on predominately inter-departmental processes. A decision was also made by the evaluation team to restrict video, voice, and digital recording at each of the operations centers due to sensitivity concerns. Lastly, the live exercise evaluation was designed to limit the number of interactions with exercise participants during exercise play to minimize interference.

2.3. Inter-Agency Process Mapping

The security environment in Canada's ports continues to evolve. Elements of concern to policy makers include threat diffusion and general expectations of the government's ability to mitigate threats and manage incidents. When it comes to consequence management the public is not inclined to differentiate between levels of government or investigate departmental mandates.   A "Whole of Government" approach is both assumed and is often necessary. This emphasizes the need for preparation to pro-actively develop an understanding of threats, vulnerabilities, systemic capabilities, shortfalls, and opportunities to realize efficiencies and ensure effects.

Multi-jurisdictional, multi-level (federal, provincial, municipal, and private sector) emergency management exercises often show that improved coordination and better interdepartmental information management protocols are needed among the large number of authorities and stakeholders involved in responding to an emergency (3)(4)(5).   Adding to the complexity of response operations is the high likelihood that the lead-department will potentially change depending on the specific nature of the evolving safety or security threat. For example, during the 2005 London train bombings, leadership was one of the primary issues reported after the response had concluded (6). The uncertainty surrounding leadership often results in the blurring of existing boundaries between organizations that has long been recognized to occur during emergency response operations (7), adding confusion to the response.

Many studies indicate the importance of establishing communication protocols and point of contact lists prior to an emergency (7). Understanding these current business practices is the starting point for process mapping. Modelling, simulation and exercises offer a valuable means to explore procedural, organization and technology innovation. Harbours provide an ideal setting for the study of interdepartmental safety and security as there is often an intersection of land and sea, and both public and private domains. Process mapping was used during the IHSC to document existing practices, provide insight and enhance awareness of interdepartmental issues.   The process mapping completed for this project helped to characterize challenges and suggest technical and procedural improvements. To maximize the limited time available for data collection from the participating agencies, a questionnaire was developed and

distributed along with a scenario synopsis. These provided a base template to collect the information required for the process mapping, such as:

- Roles and responsibilities of the departments and agencies involved;
- Current operational policies and operating procedures for the participating departments/agencies;
- Communication and information sharing mechanisms, including interdepartmental or inter-agency agreements;
- Relevant information available to share with other departments/agencies, including access to databases or other sources of information;
- Level and ease of accessibility of critical information;
- Information gaps;
- Factors affecting timely access of information and access to critical resources;
- Emergency management procedures, either as a provider of critical information, or responding agency;
- Decision-making process for the handling of the emergency; and
- Special communication procedures during the emergency.

2.4. Metric Development

Emergency management requires interagency communication and coordination (7). The goal of the metrics development for the IHSC was to identify the key performance indicators that describe interdepartmental response, and to benchmark their value through effective observation and measurement. The evaluation was based on operator's subjective opinion due to constraints on evaluator interactions with exercise participants, and data recording restrictions imposed at certain operation centers.

A series of evaluation tools were developed to assess the performance in key response areas. The components contained in each of the evaluation tools were determined through review of the guidance provided by the HSEEP, and discussion with subject matter experts with experience in each respective area of the evaluation. Whenever possible, the focus was on the development of Scenario Independent Metrics (SIM) that could be applied to a wide range of future exercises. Existing tools to measure situational awareness, such as the Situational Awareness Rating Technique (SART) and the Situational Awareness Global Assessment Technique (SAGAT) were reviewed prior to developing the evaluation. It was deemed that the SAGAT assessment was not applicable because of the requirement to stop exercise play to administer the test (8). The SART on the other hand provided a good example of an easy-to-use test that can be administered in a wide range of task types (8). *Breton et al.* provide an excellent critical evaluation of the available metrics and tools to measure individual and team situational awareness and their applicability in Command and Control (C2) environments (9).

Admittedly, the SART provided the inspiration for the look and feel of the evaluation forms developed for the IHSC, though, it was not directly applicable.   The SART is operator oriented and the evaluation for the live exercise was focused more on evaluating interdepartmental processes, not operator performance. Therefore, several new evaluation tools were developed for evaluating interdepartmental process. The overall evaluation addressed the performance, effectiveness, efficiency, and complexity of the multi-agency emergency response, including the interoperability between agencies in the following areas:

- Command and Control (priorities, command structure, reporting, documentation, roles and responsibilities)
- Communications (internal / external and formal / informal)

- Interdepartmental Information Sharing (unclassified)

Evaluation forms were chosen as the primary method of data collection during the live exercise. Evaluation forms were selected because they provide structure to data collection and observation at each of the exercise evaluation locations, and are easy to administer with little obtrusiveness. Forms are also easy to circulate prior to an exercise for approval by the participating agencies and departments. Four evaluation tools were developed, namely: Operations Synchronization Assessment Tool (OSAT), Communications Assessment Tool (CAT), Post Exercise Player Assessment (PEPA), and the Coordination Group Assessment (CGA). A 5-point scale numeric scale and comment boxes were used in all assessments to capture player and subject matter expert opinion.

2.4.1. Data Collection

Eleven agencies from the municipal, provincial, and federal levels agreed to participate in the live excise evaluation component of the IHSC. Exercise evaluators were given permission to administer the assessment forms to the players and controllers participating in the exercise. Effort was made to examine the MSEL to ensure the optimum placement of evaluators to maximize the amount of collected data. The primary consideration was how involved the agency was in the scenario and whether or not they were a key operational node.

Several constraints were observed during the data collection phase of exercise. Some agencies chose to limit the number of interactions that their players and controllers could have with the evaluators during the exercise. This affected the distribution of responses received from each of the individual agencies. The results presented in this paper represent the aggregate of all received responses. No effort has been made to normalize the number of responses used from each agency to ensure the results of an individual agency are not over-represented. For each assessment, a dashboard overview of the results will be given containing results rounded to the nearest quarter. Table 1 contains a summary of the survey responses.

Table 1: Summary of Evaluation Responses

Category	Total
Number of Locations	11
Operations Synchronization Assessment Test (OSAT)	38 responses
Communications Assessment Test (CAT)	26 responses
Coordination Group Assessment (CGA)	10 responses
Post-Exercise Player Assessment (PEPA)	32 responses

2.4.2. Operations Synchronization Assessment Tool (OSAT)

The OSAT formed the primary evaluation of command and control and information sharing. To act effectively in an emergency requires sharing and using information effectively: collecting, collating, analyzing, and then deploying it promptly in a useful form. The focus of the OSAT was on the operational synchronization of the eleven agencies participating in the exercise evaluation.

The purpose of establishing some form of operational synchronization is the maintenance of synchronized activity and process among distributed parties. It is most critical in rapidly evolving situations or in highly distributed operations (10). The emergency response associated with the live exercise in Halifax Harbour was both highly distributed and rapidly evolving. For this reason the OSAT was seen as a key assessment tool that needed to be developed for the exercise. Successful battle rhythm implies the synergism of procedures, processes, technologies, individual activities and collective action at all levels in order to facilitate the emergency response (10). The OSAT was designed to explore the level of

synchronization of planning, monitoring, and reporting between the agencies and departments participating in the assessment.

Valid and timely information sharing is critical during emergency response operations (7). It also directly impacts the level of synchronization achieved between responding agencies. A significant source of confusion during rapidly evolving emergency response operations is information ambiguity or conflicts. This was directly observed during the live exercise. Conflicting event reports being shared between the participating agencies during the exercise led to a significant divergence in planning synchronization. Table 2 provides an overview of the OSAT assessment tool.

Table 2: Overview of the components and criteria used to assess Operations Synchronization

Concept	Component	Metric	Description
Operations Synchronization	Planning Synchronization	Involvement in Decision Making	level of involvement of your agency in operational level decision making
		Knowledge of Operational Priorities	Degree to which the current operational priorities are known to your agency
		Clarity of Responsibilities	Degree to which the responsibilities of your agency are known and understood
	Monitoring Synchronization	Understanding of situation	Level of understanding of the situation
		Stability of situation	Situations degree of stability with respect to the overall emergency response
		Evolution of situation	Ability to anticipate future required actions to control the situation
	Reporting Synchronization	Clarity of Lead Agency Reporting Expectations	Clarity of the reporting expectations of the lead department. Requirements include: Type and format of information, and reporting schedule
		Reporting Cycle Demand	Ability to meet reporting requirements of the lead agency
		Appropriateness of Report Demands	Degree to which lead agency's reporting expectations utilize your agency

The OSAT assessment was dependent upon the existence of a lead agency utilizing the capabilities of multiple supporting agencies. The low numbers in the reporting category are to be expected from an exercise of only 10 hours duration (see Figure 2). Even if there are clear reporting requirements and processes in place to support operations synchronization, they are by definition time-based cyclical requirements that take some time to get established and become routine. The average response value for knowledge of operational priorities and understanding of the situation during the exercise were fairly high. During a post exercise hot wash, this was discussed and attributed to the fact that most organizations were simply executing their normal emergency mandates, requiring little interpretation of the situation.
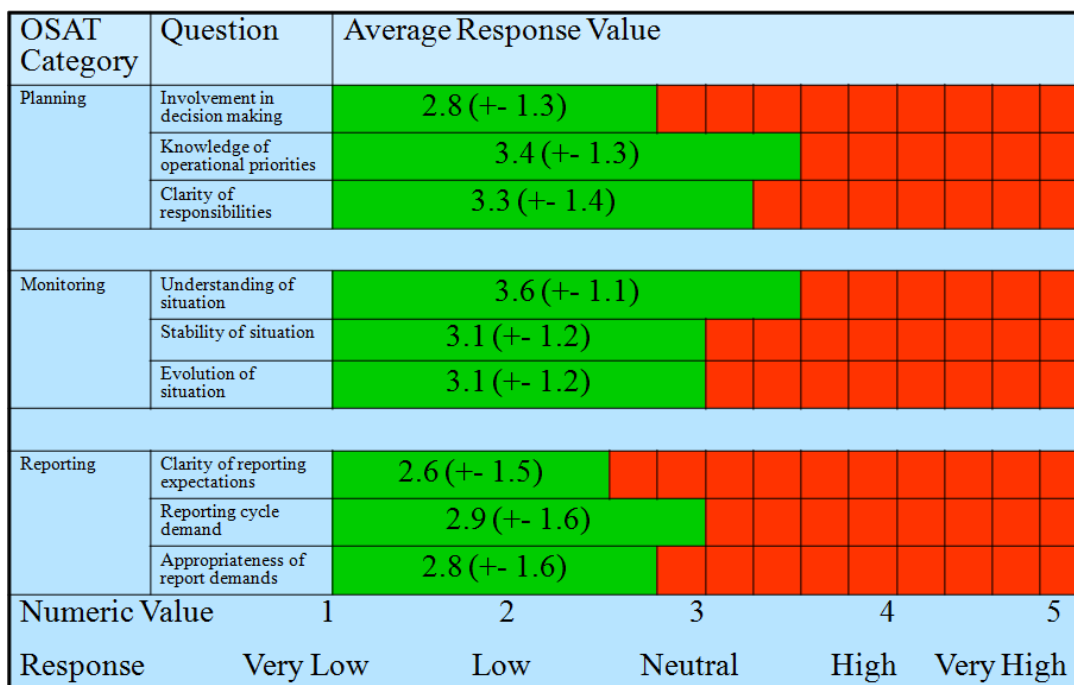
OSAT Category	Question	Average Response Value
Planning	Involvement in decision making	2.8 (+- 1.3)
	Knowledge of operational priorities	3.4 (+- 1.3)
	Clarity of responsibilities	3.3 (+- 1.4)
Monitoring	Understanding of situation	3.6 (+- 1.1)
	Stability of situation	3.1 (+- 1.2)
	Evolution of situation	3.1 (+- 1.2)
Reporting	Clarity of reporting expectations	2.6 (+- 1.5)
	Reporting cycle demand	2.9 (+- 1.6)
	Appropriateness of report demands	2.8 (+- 1.6)
Numeric Value	1	2	3	4	5
Response	Very Low	Low	Neutral	High	Very High

Figure 2: Operations Synchronization Assessment Test (OSAT) Dashboard (N = 36)

2.4.3. Communications Assessment Tool (CAT)

The communications assessment component of the evaluation looked at the interoperability, performance and effectiveness of the communications systems in use during the exercise, and the communications environment. According to the U.S. Department of Homeland Security, $2.15 billion in grant funding was awarded to states and localities from 2003 to 2005 for communications interoperability enhancements (5).

In Canada, several initiatives exist to enhance interoperability of emergency responders. Current initiatives include the development of Canadian National Information Exchange Model-Based Architectures (C-NIEM)[3], Canadian Profile of the National Common Alerting and Notification Protocol (CAP-CP)[4], and the establishment of the Canadian Interoperability Technology Interest Group (CITIG)[5]. Much work has also been done to improve exercise evaluation and improvement planning. HSEEP provided excellent guidance for the development of metrics for exercise evaluation, including the assessment of communications (2). Table 3 contains an overview of the communications assessment tool.

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[3] The U.S. National Information Exchange Model (NIEM) is an XML-based data exchange standard as well as a common lexicon that was developed by a partnership between the U.S. Department of Justice (DOJ) and the U.S. DHS. C-NIEM is a Canadian implementation of NIEM.

[4] The Common Alerting Protocol (CAP) is an XML-based data format that was developed in the United States (US) for the exchange of public warnings and emergency alerts between alerting technologies.

[5] The Canadian Interoperability Technology Interest Group (CITIG) is a partnership between Canadian Police Research Center and other key first responder associations promoting interoperability by bringing together the collective wisdom of first responder and communication leaders and experts.

Table 3: Overview of the components and criteria used to assess communications

Concept	Component	Metric	Description
Effective Communications	Communications Performance	Support of Information Requirements	The communication systems in use during the event adequately supported your critical information needs
		Support of Situational Awareness	The communication systems in use during the event adequately supported your situational awareness
		Support of Operations Synchronization	The communication systems in use during the event adequately supported operations synchronization
	Communications Effectiveness	Level of Clutter	Degree of redundant, irrelevant, or inappropriate communications
		Level of Clarity	Were received communication transmissions easily interpreted and understood?
		Level of Timeliness	Degree of latency in the communication system for a response to a request
	Communications Environment	Communications System Availability	Degree of system availability to the operator. This could include: number handsets available to the operator, or channel availability
		Communications Environment	Degree that the communications environment supports communications activity. This includes: Ambient noise, head-set availability, loud-speaker availability, room interference, communications system location relative to work station, etc.

The results of communications assessment relate to the effectiveness and performance of the communications systems in use during the live exercise. The overall results of this assessment show that most responders were satisfied with the communications during the exercise (see Figure 3). The lowest scores were in the communications effectiveness category. The challenge with this category is that it is heavily impacted by exercise artificiality. The use of alternative frequencies and non-standard communications equipment may have contributed to the low scores in this category. It would have been useful to ask exercise participants to comment on the impact alternative frequencies and non-standard equipment had on their ability to effectively communicate in order to better interpret these results.
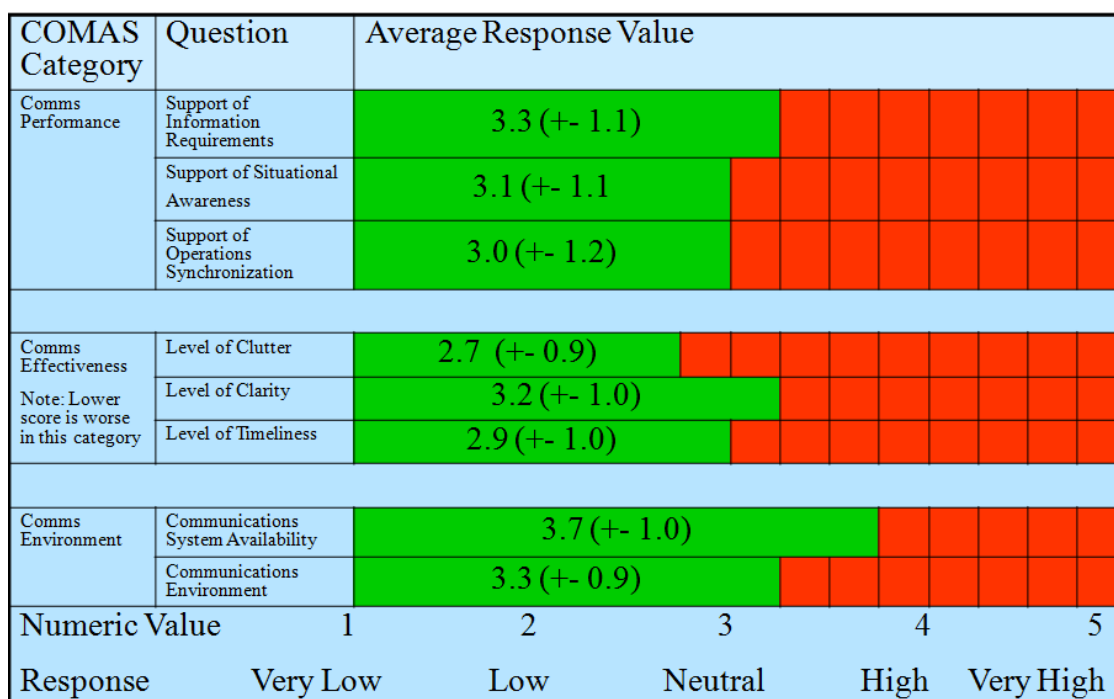
COMAS Category	Question	Average Response Value
Comms Performance	Support of Information Requirements	3.3 (+- 1.1)
	Support of Situational Awareness	3.1 (+- 1.1
	Support of Operations Synchronization	3.0 (+- 1.2)
Comms Effectiveness Note: Lower score is worse in this category	Level of Clutter	2.7 (+- 0.9)
	Level of Clarity	3.2 (+- 1.0)
	Level of Timeliness	2.9 (+- 1.0)
Comms Environment	Communications System Availability	3.7 (+- 1.0)
	Communications Environment	3.3 (+- 0.9)
Numeric Value		1 2 3 4 5
Response		Very Low Low Neutral High Very High

Figure 3: Dashboard overview of CAT results (N = 26)

2.4.4. Coordination Group Assessment (CGA)

The focus of the Coordination Group Assessment (CGA) was on the form and function of the Federal Coordination Group[6] (FCG) and the Federal Coordination Steering Committee[7] (FCSC) (11). FCSC membership reflects the emergency support functions required to respond to a given emergency. However, the composition of the FCSC membership is flexible in order to accommodate specific threats and hazards as they arise. For instance, the membership of the FCSC may be limited to security and intelligence stakeholders if a national security threat is perceived or determined to exist to ensure Operational Security (OPSEC). Other members would then be engaged as appropriate to provide assistance and advice to deal with resulting contingencies from the initial threat. The FCSC will make a collective risk-management recommendation to engage a broader community, including provincial and territorial partners, when consequence management arrangements are required to be engaged. This decision will serve as the initial activation of the National Emergency Response System (NERS). Figure 4 provides an overview of the federal regional governance within the NERS construct.

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[6] The Federal Coordination Group (FCG) is a standing committee composed of emergency management managers from federal departments in the region. The group reports to the Federal Coordination Steering Committee. The Public Safety Canada Regional Director co-chairs this group. During an emergency, the Federal Coordination Group provides emergency management planning and advice. It also provides and/or manages the flow of information and requests for federal assistance within the region.

[7] The Federal Coordination Steering Committee (FCSC) is a steering committee composed of senior regional departmental representatives. The Public Safety Canada Regional Director co-chairs this committee. The Committee provides direction on emergency management planning and preparedness activities. It also oversees the coordination of the federal regional response.

The FCG, as per its mandate outlined in the FERP, will conduct the planning and implementation of the federal regional response to an event in accordance with direction provided by the FCSC. PS acts as co-chair on both of these committees to support the lead agency and to enable effective information sharing and situational awareness with regards to the emergency response. Departments may receive information as a result of FCSC/FCG meetings that could trigger the activation of their Emergency Operations Centers (EOC), but this remains an internal departmental decision. A recommendation may be made by the FCSC/FCG to activate an EOC, but formal direction to activate EOCs does not come from the FCSC/FCG. This recommendation is based, in part, on considerations for OPSEC and command and control. Tactical operations continue to be conducted at the direction/discretion of the individual departments. The plan created by the FCG is meant to guide tactical activity in such a manner as to ensure that operational and strategic goals of the overall response are met.
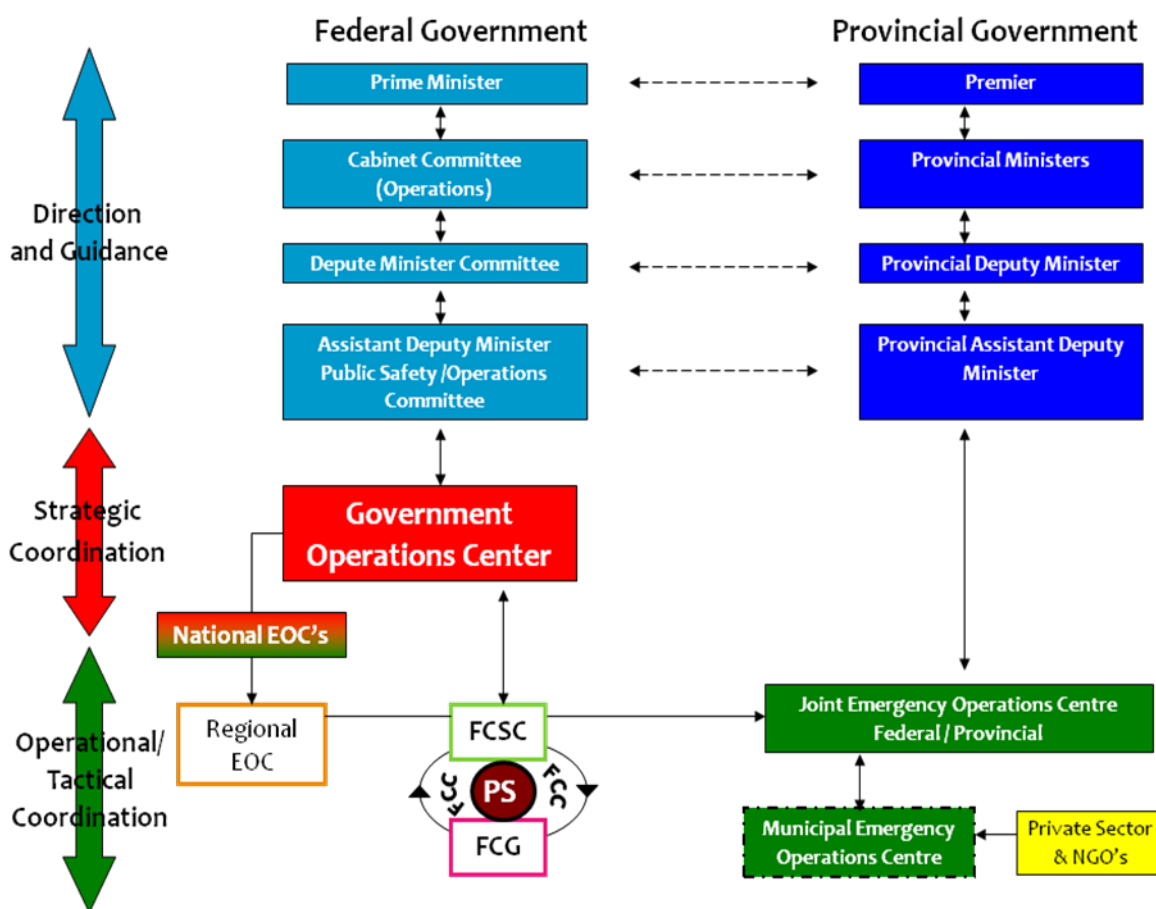
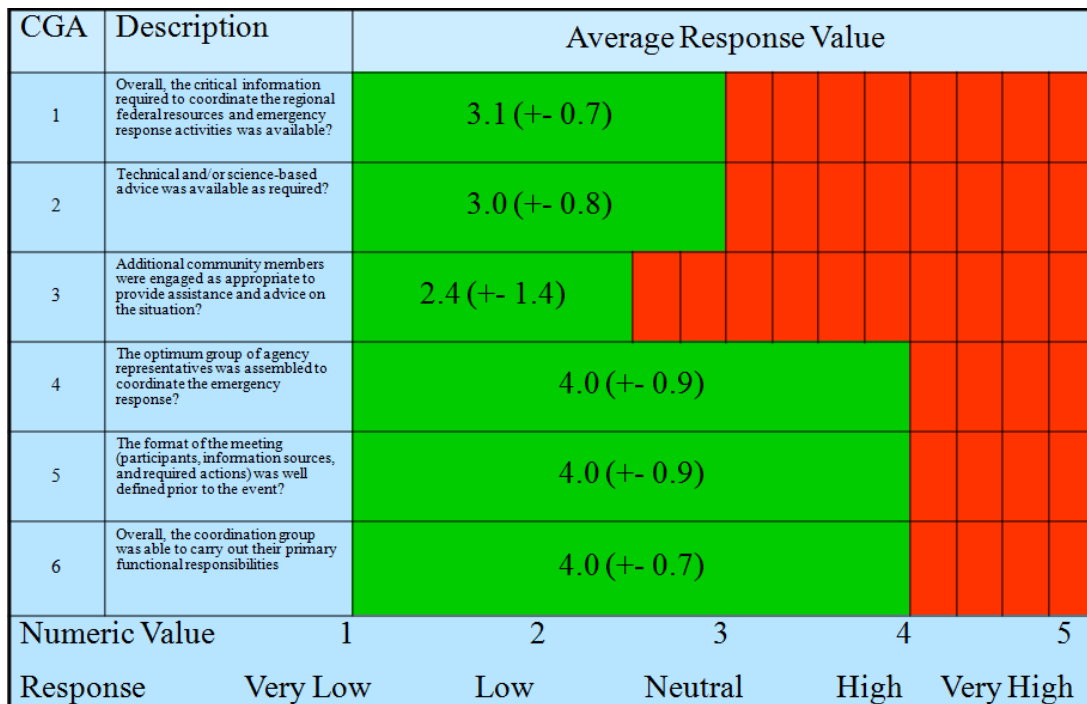Figure 4: Overview of federal regional governance within the NERS[8]

The questions posed in the CGA examined the structure of the FCG and FCSC and how they handle the coordination of regional federal actions. Following each convening of the FCG, or the FCSC, the CGA was administered to each participant in the meeting. The evaluation was based on participant's subjective opinion on the structure of the meetings and their ability to effectively make decisions. As described earlier, a five point scale was used to measure their response. Table 4 contains an overview of the CGA assessment tool.

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[8] Federal regional governance flowchart provided in part by the Nova Scotia regional office of Public Safety Canada.

Table 4: Overview of the components and criteria forming the Coordination Group Assessment

Topic	Component	Criteria
Coordination	Structure	The optimum group of agency representatives were assembled to coordinate the overall response
		The format of the meeting (participants, information sources, and required actions) was well defined prior to the event
	Decision Making	Technical and/or science-based advice was available as required?
		Additional community members were engaged as appropriate to provide assistance and advice on the situation?
		Overall, the critical information required to coordinate the regional federal resources and overall response activities was available?
		Overall, the coordination group was able to carry out their primary functional responsibilities?

The results of the coordination group assessment indicate that there was good support for the current structure and process, but that the group's situational awareness and access to the right external expertise during the coordination group meetings was low (see Figure 5). Improving situational awareness and access to external expertise are ideal candidates for technology solutions. Engaging additional community members for advice during the coordination group meetings received the lowest score in the assessment. This would indicate that future efforts should focus on technology solutions that would increase access to relevant community members as required.

CGA	Description	Average Response Value
1	Overall, the critical information required to coordinate the regional federal resources and emergency response activities was available?	3.1 (+- 0.7)
2	Technical and/or science-based advice was available as required?	3.0 (+- 0.8)
3	Additional community members were engaged as appropriate to provide assistance and advice on the situation?	2.4 (+- 1.4)
4	The optimum group of agency representatives was assembled to coordinate the emergency response?	4.0 (+- 0.9)
5	The format of the meeting (participants, information sources, and required actions) was well defined prior to the event?	4.0 (+- 0.9)
6	Overall, the coordination group was able to carry out their primary functional responsibilities	4.0 (+- 0.7)
Numeric Value		1 2 3 4 5
Response		Very Low Low Neutral High Very High

Figure 5: Dashboard results for the CGA (N = 10)

2.4.5. Post Exercise Player Assessment (PEPA)

The Post Exercise Player Assessment (PEPA) was used to assess player satisfaction in a number of key areas. The questions asked in the PEPA can be loosely grouped into three categories (See Table 5). The first category relates to the communications tools, workstation displays, and Points of Contact (POC) list used during the exercise. The second category relates to the time required to send and receive critical information and the ability to communicate with other command centres. The last category related to the reliance of an agency on informal communications to perform its mandate.

Table 5 : Overview of the components and criteria forming the Post Exercise Player Assessment

Topic	Component	Criteria
Communications	Tools	Overall, the communication tools (e.g. software, phones, VTC, secure / unsecure networks) that I used were adequate to support my requirements
		My workstation displays provided adequate support to my information requirements
	Communication Connectivity	Overall, I had the Points of Contact (POC) I needed to send information appropriately
		Overall, the amount of time required to transmit critical information was acceptable
		Overall, the amount of time required to receive critical information was appropriate
		Overall, communication with other command centres and agencies was adequate
	Informal Communications	Overall, informal communications methods were important in fulfilling your duties and for passing information

The results of the post exercise assessment present a relatively positive opinion of the tools the players used to perform their job and their ability to share information with other agencies (see Figure 6). Communications with other command centres received the lowest score during the post exercise player assessment. The relatively positive response to the question of having the correct points of contact is offset by a commensurate level of use of those contacts to support a reliance on informal communications methods to fulfil information needs. This is reflected in feedback that indicated a number of organizations simply used informal methods to try to build situational awareness in the absence of a common emergency management system. This latter observation is puzzling in the context of the equally high response to the second question, which would indicate their current tool supported their information requirements to a relatively high degree. The response to the second question does not seem to have been supported by anecdotal feedback.
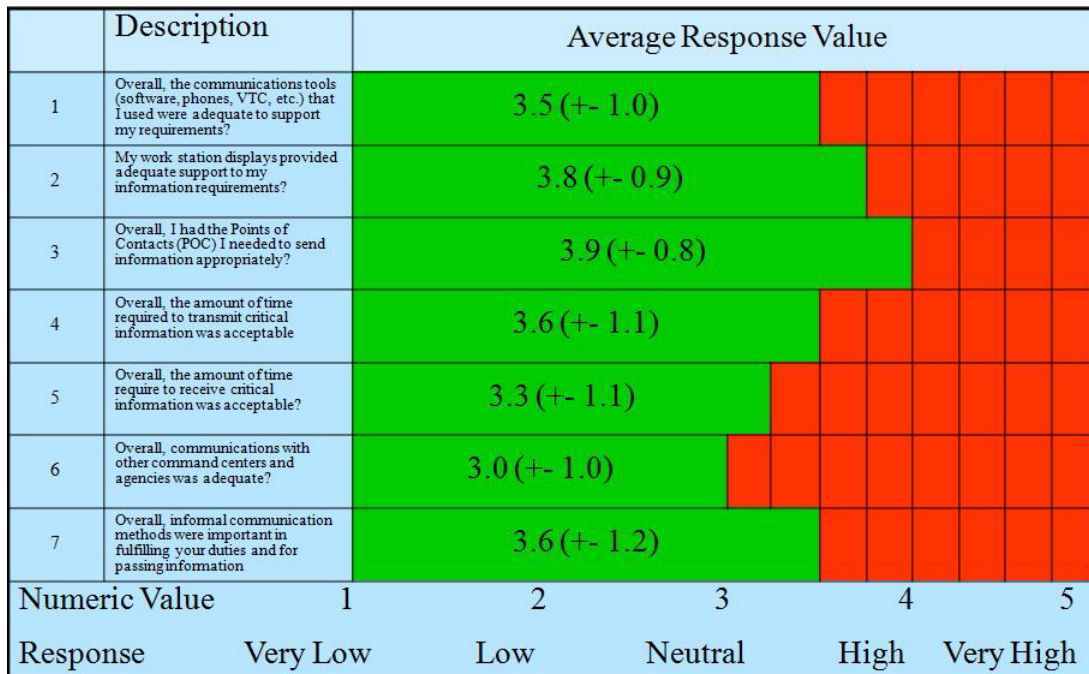
	Description	Average Response Value
1	Overall, the communications tools (software, phones, VTC, etc.) that I used were adequate to support my requirements?	3.5 (+- 1.0)
2	My work station displays provided adequate support to my information requirements?	3.8 (+- 0.9)
3	Overall, I had the Points of Contacts (POC) I needed to send information appropriately?	3.9 (+- 0.8)
4	Overall, the amount of time required to transmit critical information was acceptable	3.6 (+- 1.1)
5	Overall, the amount of time require to receive critical information was acceptable?	3.3 (+- 1.1)
6	Overall, communications with other command centers and agencies was adequate?	3.0 (+- 1.0)
7	Overall, informal communication methods were important in fulfilling your duties and for passing information	3.6 (+- 1.2)
Numeric Value	1	2	3	4	5
Response	Very Low	Low	Neutral	High	Very High

Figure 6: Dashboard results for the PEPA (N = 32)

3. Challenges

3.1. General

The assessment of stakeholder interoperability was identified as a primary objective of the metrics and evaluation developed for the IHSC. Live exercises provide an excellent opportunity to examine command and control procedures, as well as stakeholder roles and responsibilities. Direct observation provides the basis for evidence-based recommendations, and aids in the development of lessons learned. Not all agencies and departments have the same views towards observation-based assessments. Observations made during exercises could be viewed by some as an auditing activity, which may have a negative connotation. It is important during the early exercise planning stages to clearly articulate the measurement and assessment objectives, and ensure that they are understood and agreed on by all stakeholders. Allowing an external observer/evaluator into a normally closed operations center is not a trivial decision, and approval for such activity should not be taken for granted.

The exercise brought together a very diverse group of agencies and departments. Some agencies involved in the exercise have never participated in an interdepartmental training exercise, and some had never been exposed to observation by an external evaluator. In this sense, the exercise provided many firsts for some of the participating agencies. Prior to deploying evaluators during the exercise a significant effort was required to develop a relationship with the participating agencies and departments to ensure they understood the purpose of having an evaluator at their location. These relationships form the backbone of an effective evaluation plan and should be fostered as early as possible in the exercise planning. Access to the right place at the right time is crucial in order to conduct an effective evaluation during a live exercise, and is not possible without the explicit support of the participating agencies.

3.2. Process Mapping

Part of the IHSC focused on the collection of operating procedures and practices for the harbour of Halifax to produce a harbour security process map. Process mapping has been successfully used to examine existing interdepartmental processes and to provide a starting point for process improvements. Halifax Harbour provided a very challenging scenario for harbour security process mapping. Challenges encountered were the multitude of stakeholders, the potential for overlapping jurisdictions, and the existence of draft interdepartmental emergency standard operating procedures.

Process mapping is in some cases too rigid to handle the rapidly evolving non-linear world of emergency management. Routine work is characterized by a linear and sequential process of conversion of inputs into outputs. Process mapping excels in describing these situations where the relationship between inputs and outputs are both well known and understood. However, multi-agency emergency response represents non-routine work, which is characterized by multiple, concurrent and non-linear processes, where issues cannot be resolved simply by being plugged into an elegant model or established procedures (12).

Standard operating procedures for emergency management represent fixed procedure, but are difficult to define for all possible ranges of events. Management actions are scenario dependant and can be characterized by several parameters with potential non-linear interactions such as, the nature of the emergency, geographic location, and available resources. For a fixed scenario covered by well defined standard operating procedures, a process map can be produced. If the scenario changes and falls outside the scope of the standard operating procedure, the process map will not necessarily remain valid.

Producing a process map for a live exercise is greatly aided by the development of a detailed MSEL. A MSEL provides a timeline of events for the live exercise and often contains event triggers and expected actions. Expected actions are actions assigned to a specific agency, based on Standard Operating Procedures (SOP), Service Level Agreements (SLA), and Memorandum of Understanding (MOU), in response to an event contained in the MSEL. The expected actions in a MSEL are often based on expert judgment during the planning sessions when the MSEL is created.

The MSEL produced by PS was instrumental in the construction of a process map of the live exercise. Unfortunately, as the MSEL is periodically updated to reflect changes to the exercise, the process map must also be updated to remain valid. The MSEL provided information on roles and responsibilities, existing operating procedures, communication and information sharing mechanisms, and emergency management and decision making function during the exercise. A good MSEL provides an "As Is" process map as understood by the SME representing the participating agencies and departments.

3.3. Metrics

As stated earlier, it is of the utmost importance to clearly articulate the measurement and assessment objectives during the early exercise planning stages, and to ensure that they are understood and agreed on by all stakeholders. Often data collection and observation becomes a low priority in a hectic operations center during a live exercise. This was indeed the case at several locations where observers were deployed during the live exercise. The impact of this was minimized by limiting interactions with exercise players and instead focusing on SME who were not directly involved in the live exercise. The SME were knowledgeable of the roles and responsibilities of the agency/department, and were well versed in the standard operating procedures being used by the exercise participant. The SME were also typically the internal evaluator of the given agency and therefore were fully aware of the exercise events and relevant internal agency processes to be exercised. The pairing of an evaluator with a SME is ideal in an operations center where direct access to an exercise player will be limited or discouraged.

The development of evaluation tools that are designed to assess multi-agency interoperability comes with its own unique set of challenges. Evaluation tools must not be too specific, as many agencies are involved and do not come from the same backgrounds (i.e. civil or military). Concepts and wording contained in the evaluation tools must not be domain specific to ensure that the results can be compared across stakeholders.

Producing a holistic assessment posed a significant challenge for the IHSC given the diversity of participating agencies and departments. This is a fact of life in a busy harbour setting where many public and private interests intersect and jurisdictions may overlap. The evaluation tools deployed during the IHSC attempted to focus on general concepts that were common to the community of stakeholders. Effort was made to identify concepts, components, and metrics that would be understood by all stakeholders participating in the live exercise.

A one day exercise that must finish on schedule does not allow for rigorous time-based assessments of interoperability. The time from when an event is triggered to when the expected response action must occur is pre-determined. The live exercise had a significant amount of free play, but it still had to follow a schedule wherein exercise controllers were responsible to force expected actions in accordance with the MSEL timeline. This artificiality makes the interpretation of rigorous time-based observations difficult to interpret and of limited use. Artificiality also affected the assessment of interdepartmental decision making and information sharing since the output of these activities had to progress in accordance with the MSEL timeline.

Information sharing is greatly influenced by existing relationships when time is a factor, often contradicting expected information flow. Early during the development of metrics for the IHSC, information tracking formed a signification portion of the assessment. Emphasis was later shifted away from tracking information because of the impact it would have on the exercise participant and the demands it would place on the observer. Since a decision was made during the IHSC to restrict the recording of video, voice, or digital information during the live exercise it would be a significant challenge for them to track information exchanges in a busy operations center. In an exercise where recording of video, voice, and digital information are permitted, exercise reconstruction and play back could enable information tracking post exercise.

3.4. Future Work

In the future, more effort will be made to establish common performance measurement goals among stakeholders in Harbour security prior to future exercises. The assessment completed as part of the IHSC did not focus on establishing common measurement goals, but may have benefited greatly if it had. As an example, if a common measurement goal had been to evaluate the effectiveness of existing SLA, then the evaluation would focus on identifying SLA between agencies and evaluating their ability to support existing requirements. This would enable a conventional approach to developing metrics that derives from a problem statement and subsequent identification of determinant factors and key performance parameters.

Another potential area for study is the development of self-reporting standards for harbour security live exercises. Establishing self-reporting standards would promote more effective data management and allow agencies to better track and report their own progress, eliminating the requirement for external evaluators to access sensitive locations during an exercise, as discussed in 3.1. This would also result in a reduction in the number of individuals required to be present at a given exercise location which, based on experience, would be viewed as significant benefit.

4. Conclusions

Most emergencies in Canada are local in nature and are managed at the municipal or provincial/territorial level. However, certain risk factors increase the potential for catastrophes to transcend geographical boundaries and to challenge the capacity of federal and provincial/territorial governments to manage emergencies(11). Harbour security challenges existing capacity because of the multiplicity of threats - air, land and water, and because of the potential for overlapping jurisdictions within the harbour environment. The IHSC provided the first assessment of interdepartmental process of this type in Halifax Harbour. The live exercise provided a useful forum for stakeholders at all levels to exercise their capacity to respond effectively to marine-based safety and security incidents.

Given the large number of participants involved in marine safety and security in Halifax Harbour, several key challenges associated with developing a comprehensive evaluation where encountered, as described in section 3. The process mapping activity associated with the IHSC yielded several interesting observations during its completion. The first is that the initial planning conference (IPC), mid planning conference (MPC), and the final planning conference (FPC), where the exercise design team and stakeholders gather, provides an excellent venue to answer questions and resolve ambiguities relating to information gaps associated with process mapping.

Planning conferences are made up of SME from each respective stakeholder that are often very adept at answering questions relating to interdepartmental processes. These same individuals are also ideal to be paired with exercise observers during a live exercise to help limit the number of interactions with busy exercise participants. They often provide context during observation and have a better understanding of the bigger picture as it relates to their organization. Second, the MSEL provides an excellent starting point for process modeling associated with a live exercise. One note of caution is that this activity should only be initiated once the MSEL is sufficiently mature. An exercise MSEL may be developed through several iterations, forcing changes to existing process models to reflect the changes.

Similar to the observations made during the process modeling completed for the IHSC, the development of metrics also yielded several interesting observations. The first is that if metrics and the subsequent evaluation are to form an integral part of a live exercise they must be presented as early as possible in the planning process. Experience gained during the IHSC highlight the importance of fostering relationships with all stakeholders to ensure that data collection and observation does not become a low priority on the day of the exercise. Also, effort should be made to try and produce SIM for use during a live exercise to promote reusability and potentially increase continuity between exercises. Due to limited training resources the same emergency scenario is almost never used twice. The lack of commonality between exercises makes the comparison of results difficult. SIM offer one opportunity to increase the continuity between emergency management exercises.

The IHSC and the live exercise designed and led by PS represent a part of the investment by the Government of Canada to improve marine security in Canada's territorial waters and shore facilities. The results of these two investments will be used by individual exercise stakeholders to improve their internal processes and by the broader S&T community to help enhance harbour security in Canada. Interoperability is not something you want to create during emergencies; it must become part of steady state normal operations. The relationships formed during the IHSC and participation in the live exercise will serve to improve interoperability and emergency management in Halifax Harbour.

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Outline

- Overview

- Metrics Development

- Exercise Scenario

- Performance Model

- Results

- Concluding Remarks

Overview

- Marine security, specifically port and harbour security, has been identified as one of the Government of Canada's priorities

- Harbour security is a complex problem because of the multiplicity of threats - air, land and water, and because of the potential for overlapping jurisdictions within the harbour environment

- In response, Defence Research and Development Canada – Atlantic examined existing inter-agency processes in a major harbour and developed metrics for use during a live multi-agency harbour safety and security exercise

Common Marine Security/Safety Examples

Human Trafficking

Waterside Attacks

Drug Smuggling

On-Water Fires

Metrics Development

- The goal of the metrics development for the IHSC was to identify the key performance indicators that provide insight into interdepartmental emergency response, and not simply numbers

- The evaluation was based on operator's subjective opinion due to constraints on evaluator interactions with exercise participants, and data recording restrictions imposed at certain operation centers.

- The focus was on the development of Scenario Independent Metrics (SIM) that could be applied to a wide range of future exercises.

Metrics Development

- Due to limited training resources the same emergency scenario is almost never used twice.

- SIM offer one opportunity to increase the continuity between emergency management exercises by addressing common elements of a wide range of emergency response scenarios

  - What you lose in fidelity you gain in sample size and improved continuity between exercises

Metrics Development

- A series of evaluation tools were developed to assess;

    – Command and Control

    – Communications

    – Interdepartmental Information Sharing

- The components contained in each of the evaluation tools were determined through review of the guidance provided by the U.S. Homeland Security Exercise and Evaluation Program (HSEEP), and discussion with subject matter experts with experience in each respective area of the evaluation

Scenario Overview

- The general scenario for the exercise was divided in two geographic areas with three main events

  - While at anchor, a string of explosions onboard a container ship occur. A container containing Sodium hydrosulphite ignites producing a plume of toxic smoke that is carried inland

  - A body of a foreign national non-crewmember was found near the stricken vessel with ties to a terrorist organization

  - A security incident at an waterside oil production facility occurs that may be linked to the explosion on the container ship

Federal Government

Prime Minister

Cabinet Committee (Operations)

Depute Minister Committee

Assistant Deputy Minister Public Safety /Operations Committee

Provincial Government

Premier

Provincial Ministers

Provincial Deputy Minister

Provincial Assistant Deputy Minister

Direction and Guidance
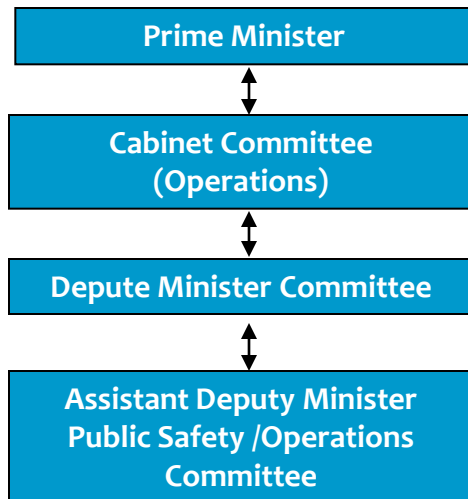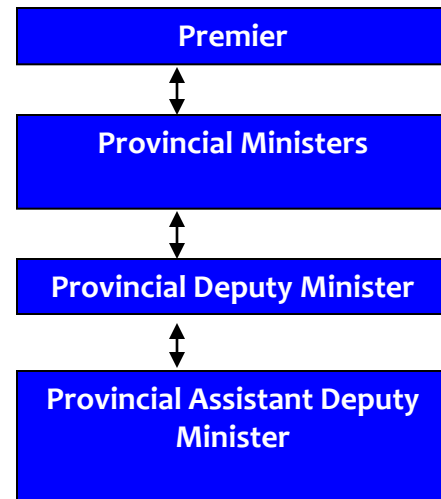
Strategic Coordination

Operational/ Tactical Coordination

Government Operations Center

National EOC's

Regional EOC
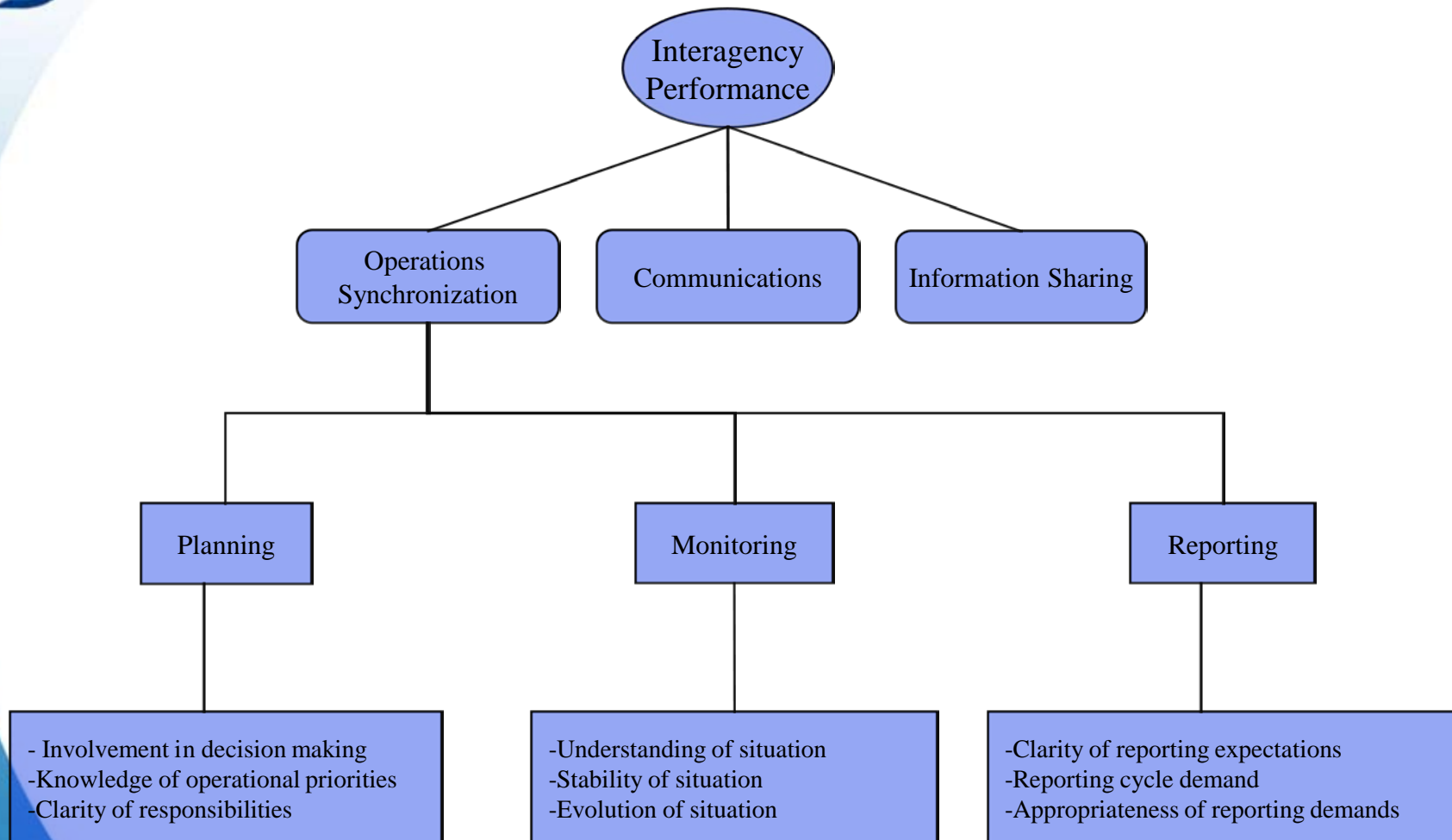
FCSC

FCC   PS   FCC

FCG

Joint Emergency Operations Centre Federal / Provincial
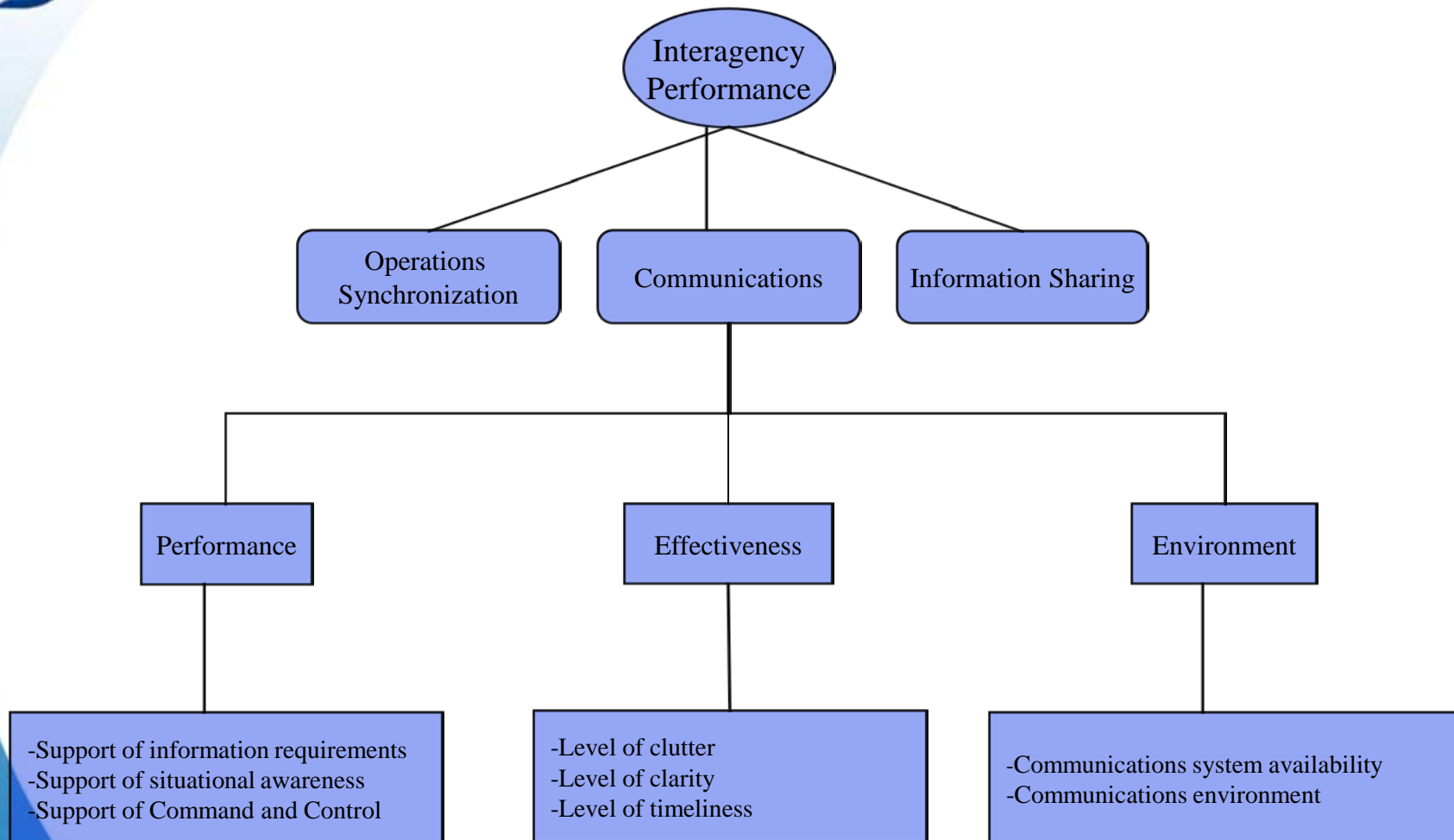
Municipal Emergency Operations Centre
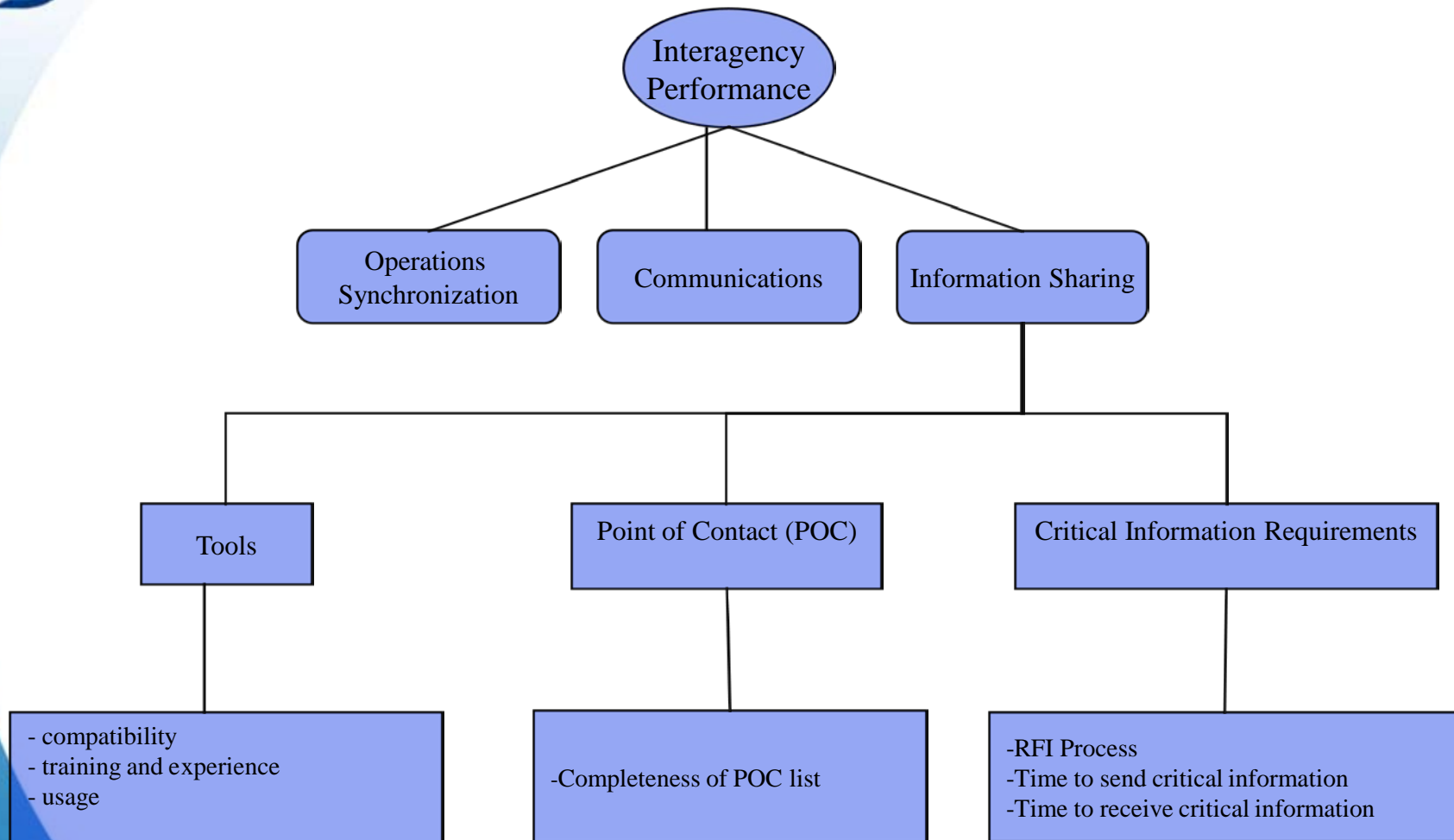
Private Sector & NGO's

Exercise Performance Model

Exercise Performance Model

Exercise Performance Model

Interagency Performance

- Operations Synchronization
- Communications
- Information Sharing

Information Sharing:
- Tools
- Point of Contact (POC)
- Critical Information Requirements

Tools:
- compatibility
- training and experience
- usage

Point of Contact (POC):
-Completeness of POC list

Critical Information Requirements:
-RFI Process
-Time to send critical information
-Time to receive critical information

Results

- Number of Locations = 12

- Operations Synchronization Assessment Tool (OSAT)

  - 38 responses

- Communications Assessment Tool (CAT)

  - 26 responses

- Coordination Group Assessment (CGA)

  - 10 responses

- Post Exercise Player Assessment (PEPA)

  - 32 responses

Results

- Number of Locations = 12

- Operations Synchronization Assessment Tool (OSAT)

  – 38 responses

- Communications Assessment Tool (CAT)

  – 26 responses

- **Coordination Group Assessment (CGA)**

  – **10 responses**

- Post Exercise Player Assessment (PEPA)

  – 32 responses

Coordination Group Assessment

Meeting Group:				Location:			Time:	
Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Not Applicable**			
1	2	3	4	5	n/a			

Question	Description	Response					
1	Overall, the critical information required to coordinate the regional federal resources and overall response activities was available?	1	2	3	4	5	n/a
2	Technical and/or science-based advice was available as required?	1	2	3	4	5	n/a
3	Additional community members were engaged as appropriate to provide assistance and advice on the situation?	1	2	3	4	5	n/a
4	The optimum group of agency representatives was assembled to coordinate the overall response	1	2	3	4	5	n/a
5	The format of the meeting (participants, information sources, and required actions) was well defined prior to the event	1	2	3	4	5	n/a
6	Overall, the coordination group was able to carry out their primary functional responsibilities?	1	2	3	4	5	n/a
Comments:							

Dashboard Results (Coordination Group)

CGA	Description	Average Response Value				
1	Overall, the critical information required to coordinate the regional federal resources and emergency response activities was available?	3.1 (+- 0.7)				
2	Technical and/or science-based advice was available as required?	3.0 (+- 0.8)				
3	Additional community members were engaged as appropriate to provide assistance and advice on the situation?	2.4 (+- 1.4)				
4	The optimum group of agency representatives was assembled to coordinate the emergency response?	4.0 (+- 0.9)				
5	The format of the meeting (participants, information sources, and required actions) was well defined prior to the event?	4.0 (+- 0.9)				
6	Overall, the coordination group was able to carry out their primary functional responsibilities	4.0 (+- 0.7)				
Numeric Value		1	2	3	4	5
Response		Very Low	Low	Neutral	High	Very High

Comments

- What these results indicated was that there was quite good support for the current structure and process related to the FCG, but that the group's situational awareness and access to the right external expertise during meetings was low.

- Improving situational awareness and access to external expertise are ideal candidates for technology solutions.

- Engaging additional communities members for advice during the coordination group meetings received the lowest score in the assessment. This would indicate that efforts should focus on technology solutions that would increase access to relevant community members as required.

Lesson Learned

- Try to establish common measurement goals among stakeholders and introduce your metrics early.

- Take advantage of exercise planning conferences

- Accept that not everyone is as excited about performance measurement as you might be

- Try to build good relationships with the agencies that will be participating in the evaluation

- Ensure that the metrics are not relegated to a low priority during hectic exercise play

- Try to team your observer with a SME from each respective agency

Future Work

- Work to establish self-reporting standards for agencies participating in emergency management exercises

    - This would promote more effective data management

    - Reduce the number of external evaluators

    - Reduce the number of evaluators required at busy operations centers

Conclusions

- The results of this assessment best serve as a benchmark for comparison with future evaluations

- As new operating procedures and technology solutions are introduced, we can now begin to explore the positive or negative affect these changes have with respect to the existing assessment results gathered during this exercise.

- The lessons learned from this exercise will help to refine the concepts and questions that made up this evaluation